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# Carbon and nitrogen mineralization and enzyme activities in soil aggregate-size classes: Effects of biochar, oyster shells, and polymers

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## HIGHLIGHTS

- Oyster shell (OS), biochar (BC), and biopolymer (BP) changed N-cycling in soil.
- Addition of OS to BC and to BP increased $NO_3^-$ in soil.
- OS alone or with BC or BP increased soil chitinase and aminopeptidase activities.
- BC/BP and OS contributes to soil fertility improvements and C sequestration.

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## ABSTRACT

Biochar (BC) and polymers are cost-effective additives for soil quality improvement and long-term sustainability. The additional use of the oyster shells (OS) powder in BC- or polymer-treated soils is recommended as a nutrient source, to enhance aggregation and to increase enzyme activities. The effects of soil treatments (i.e., BC (5 Mg $ha^{-1}$) and polymers (biopolymer at 0.4 Mg $ha^{-1}$ or polyacrylamide at 0.4 Mg $ha^{-1}$) with or without the OS (1%)) on the short-term changes were evaluated based on a 30-day incubation experiment with respect to several variables (e.g., $CO_2$ release, $NH_4^+$ and $NO_3^-$ concentrations, aggregate-size classes, and enzyme activities in an agricultural Luvisol). The BC and BP with the addition of OS increased the portion of microaggregates (<0.25 mm) relative to the control soil without any additions, while PAM alone increased the portion of large macroaggregates (1–2 mm). Concentrations of $NO_3^-$ also increased in soils treated with OS, OS + BC, and OS + BP as result of the increased chitinase and leucine aminopeptidase activities. The BC and BP when treated with the additional OS had significant short-term impacts on N mineralization without affecting C mineralization in soil. Consequently, the combination of BC or BP with OS was seen to accelerate N turnover without affecting C turnover (and related C losses) from soil. As such, the addition of these additives contributed considerably to the improvement of soil fertility and C sequestration.

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## 1. Introduction

The deficiency of C and N limits the quality and productivity of many soils (Lee et al., 2009; Katsalirou et al., 2010). Mineralization of C and N through decomposition of soil organic matter (SOM) exerts dominant controls on nutrient bioavailability (Weintraub and Schimel, 2003; Rothlisberger-Lewis et al., 2016). Furthermore, soil aggregates alter SOM decomposition as microaggregates may occlude SOM, and render it inaccessible to microbial decomposition (Awad et al., 2013; Kuzyakov et al., 2014). The decomposition of

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